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Early Intervention of Non-Invasive Positive Pressure Ventilation in Elderly Patients with Rib Fractures

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by

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Abstract

Rib fractures in the elderly population, 65 years and older, is more prevalent than any other population. Mortality increases with each year over the age of 65 and with each number of ribs fractured. Rib fractures are painful and can lead to a decreased respiratory effort. This results in complications such as pneumonia, respiratory depression, respiratory failure, Acute Respiratory Distress Syndrome (ARDS), and respiratory infections. Non-Invasive Positive Pressure Ventilation (NIPPV) assists with reducing the patient efforts to breathe while also ensuring spontaneous lung expansion. NIPPV can assist with promoting positive outcomes in patients with respiratory complications. The purpose of this study was to analyze the effectiveness of early NIPPV intervention in elderly patients with rib fractures. A retrospective data analysis was completed with a total of 117 patients from 2013 and 2014. The data included time frame from arrival to NIPPV intervention, unplanned ICU admission and length of stay, overall hospital length of stay, need for other invasive interventions, ISS, pre-existing comorbidities, complications, pain management, and discharge disposition. Patients who never had NIPPV intervention had a significantly lower LOS in the ICU and hospital than those that required NIPPV in the first 24 hours or greater. Patients with complications were significantly more likely to have NIPPV within the first 24 hours or more. Patients admitted to the ICU were significantly less likely to never have had NIPPV. Time until NIPPV intervention was not significant in the LOS of ICU patients or overall hospital LOS. The beneficial factor of early intervention of NIPPV could be disguised by the fact more serious complications require NIPPV intervention. The study did not show significance for correlations with positive or negative outcomes and NIPPV intervention.

NIPPV intervention in elderly patients 65 years and older with rib fractures is a proactive approach in potentially decreasing complications and negative outcomes.

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CHAPTER I

Introduction

Hospitals across the nation are striving for excellence in quality and safety. Our population is aging and the focus should be shifted toward earlier interventions and preventative measures. Motor vehicle collisions and falls are the two main types of trauma in our elderly population. Rib fractures are common in these types of traumas and can lead to an increase in mortality. It is extremely important to ensure adequate ventilation as soon as possible. Non-Invasive Positive Pressure Ventilation (NIPPV) is one method that can be implemented initially and lead to better outcomes.

Significance

Thoracic trauma is an injury to the chest wall that may or may not require surgical intervention. Rib fractures are commonly seen with blunt force to the thoracic area. Chauny et al. (2012) described the prevalence of thoracic trauma as 12 people per million per day. This results to 796,000 Emergency Department visits per year. Nearly two-thirds of patients with chest injuries are diagnosed with rib fractures (Abdulrahman et al., 2013). The most common causes of chest trauma are motor vehicle collisions, resulting in 70% of reported chest trauma. Falls are the second leading cause of chest injuries, resulting in 22% of reported chest trauma (Lu, Huang, Liu, Liu, & Kao, 2008). Lu et al. (2008) described one rib fracture occurring 32% of the time, two rib fractures occurring 32% of the time, and three or more rib fractures occurring 36% of the time.

Rib fractures are painful. This pain will cause patients to have shallow breathing which can lead to other complications such as pneumonia and respiratory failure. Abdulrahman et al. (2013) described how age plays a role in outcomes. Studies showed a

negative impact on clinical outcomes starting at the age of 45 but worsening at the age of 65 (Abdulrahman et al., 2013). It is important to ensure these rib fracture patients are treated quickly and effectively to ensure positive outcomes. NIPPV can assist with reducing the patient's efforts to breathe while also ensuring spontaneous lung expansion, ultimately resulting in more positive outcomes (Kallet, 2011).

The population of the older adult is on the rise. By the year 2030, the population is expected to be 20% of people over the age of 65 (Winters, 2009). This will result in a larger number of older adults involved in traumatic accidents. As research has proven the older population is at greater risk for poorer outcomes. Winters (2009) described a study in which 65% of older adults (>65 years) were admitted with rib fractures following thoracic trauma. Out of these admissions, there was an 18% mortality rate (Winters, 2009). Winters (2009) also described how 12 studies were conducted and eight of the studies proved age as an independent predictor of hospital mortality. One of these eight studies described by Winters (2009) displayed how mortality increased by 5% every year after the age of 65. Another one of these eight studies demonstrated how mortality started to increase as early as the age of 40 (Winters, 2009).

Pneumonia was also considered one of the most serious complications following rib fractures for the older population. This population was four times more likely to die than those that did not develop pneumonia (Winters, 2009). Without these facts, rib fractures could be viewed as a minimal concern when looking at the possibilities of diagnosis with thoracic trauma. However, rib fractures can lead to a decreased respiratory effort which can cause major complications, resulting in increased mortality rates.

Problem Statement

Currently, there is not a pro-active standard approach in how to treat elderly patients with rib fractures. Research proved the need for adequate ventilation to decrease further complications (Daily & Wang, 2011). There is a need to standardize early intervention of ventilation in the elderly population, 65 years and older, with rib fractures.

Purpose

The purpose of this research was to evaluate the effectiveness in early intervention of NIPPV in older adults, 65 years and older, with rib fractures. If respiratory failure, acute respiratory distress syndrome (ARDS), pneumonia, and other complications can be prevented by implementation of NIPPV at the time of rib fracture diagnosis, then mortality rates and negative outcomes should improve. Dispositions will be assessed to analyze level of independence once discharged from the hospital. The length of stay in the hospital, both in the Intensive Care Unit (ICU) and medical floors, should decrease. The need for more invasive procedures (mechanical ventilation pre and post NIPPV, chest tubes, surgeries, thoracentesis, arterial lines, and tracheostomies) should also decrease. This would ultimately decrease hospital costs both for the patient and organization. The patients with higher Injury Severity Scores (ISS) should also have better outcomes if NIPPV is utilized over those that did not have NIPPV as an intervention.

Conceptual Framework

Presenting symptoms and/or risks of symptoms will drive intervention of NIPPV in the older adult with rib fractures. This research was based on the Symptom Management Model from the Theory of Symptom Management. The University of

California, San Francisco developed this model. In an article, Dodd et al. (2011) elaborated on this model. It assumed the study of symptoms was based on the patient's perception and self-report. The symptom did not have to be experienced but the patient must be at high risk for developing the symptom.

Intervention strategies can also be implemented before the patient experiences the symptoms. Nonverbal patients can experience symptoms that the caregiver can assist with interpreting and intervening. The management strategy may be directed toward a specific patient, group, family, or work environment. The model can be modified to target individual outcomes. This model will work well with implementation of NIPPV in older adults with rib fractures. Pain, decreased vital capacity, and decreased respiratory effort, are all symptoms related to rib fractures. Each individual may need different interventions (such as an epidural, chest tube, NIPPV, or intubation) and this model will allow for each symptom to be treated based on the specific need.

Research Question

Does early NIPPV intervention promote positive outcomes among older adults, 65 years and older, with a rib fracture diagnosis? Positive outcomes that would be measured are: the need for other invasive interventions due to complications, type of admission unit (Critical care, Stepdown, Medical), length of stay in the Critical Care, hospital length of stay, and disposition.

Definition of Terms

Non-Invasive Positive Pressure Ventilation: "a form of mechanical ventilatory support delivered through a face or nasal mask, without the use of an endotracheal tube or other invasive airway device (Daily & Wang, 2011, p. 432)". This form of ventilation

creates a positive pressure, which is pushed into the lungs and assists with pulmonary function. Ventilation is improved by reducing work of breathing, improved gas exchange through open alveoli, increased intrathoracic pressure, decreased venous return, decreased air trapping, and assisted exhalation efforts.

Respiratory Failure: Respiratory failure can be acute or chronic. It occurs when the normal gas exchange is altered causing oxygen and carbon dioxide to not flow as normal. This normally results in the need for quick intervention to prevent hypoxia.

Acute Respiratory Distress Syndrome (ARDS): "a clinical syndrome of severe dyspnea of rapid onset, hypoxemia, and diffuse pulmonary infiltrates leading to respiratory failure. ARDS is caused by diffuse lung injury from many underlying medical and surgical disorders (Levy & Choi, 2012, Ch. 268)."

Injury Severity Score (ISS): "The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score and is allocated to one of six body regions (Head, face, Chest, Abdomen, Extremities (including Pelvis), and External). Only the highest AIS score in each body region is used. The three most severely injured body regions have their score squared and added together to produces the ISS score. The ISS score takes values from 0 to 75 (Square, 2010, p.1)."

Conclusion

Early intervention of NIPPV in patients 65 years and older with rib fractures would assist with enhancing ventilation, decreasing mortality rates, and improving outcomes. This intervention is also non-invasive and may prevent other invasive

interventions from occurring. Hospital length of stays should be decreased and quality of care would be increased.

CHAPTER II

Literature Review

The elderly population is at an increased risk for complications after injury due to other comorbidities and changes that occur with the aging body. Rib fractures increase the risk for complications in the elderly population. It is essential to understand how to best improve ventilation without invasive measures to improve outcomes. A thorough literature review has been completed to provide the foundation of support for early intervention of NIPPV in older adults, 65 years and older, with rib fractures. This review was completed through the Cumulative Index for Nursing and Allied Health Literature (CINAHL).

Literature Related to Statement of Purpose

Age

Several physiological changes occur as the body grows older. Sarkar (2009) elaborated on the growing elderly population. The prediction was by 2031, 23% of the United Kingdom's population will be 65 years or older. Some of these physiological changes directly correlated with an increased risk of rib fractures and complications following a traumatic event. These included decreased elasticity of airways and thoracic cage, collapse of alveolar during tidal ventilation, stiffened rib cage, increase dependency on diaphragm, reduced bone density, arthritis, reduce muscle mass and strength, and spinal column changes. Chest trauma resuleds in two-thirds of the patients being diagnosed with rib fractures. These are associated with pulmonary complications. Given the trauma severity score, comorbidities, and number of rib fractures, people 65 years and older are five times more likely to die than those less than 65 years old.

Complications are more prevalent in the elderly population, 65 years and older. Yee, Cameron, and Bailey (2006) described an Australian study. The study concluded mortality in those patients, 65 years and older, was double that of those less than 65 years old. Rib fractures, sternal fractures, and flail chest were more predominate in the 65 year and older group. Hospital lengths of stays were also increased for this population as compared to the 65 years and under. The older age group's average length of stay was 7.96 days compared to the younger group of 5.31 days.

The elderly population is at a higher risk for complications after rib fractures. Burlew and Moore (2014) focused on the specifics related to trauma in the elderly population. Patients greater than 65 years of age were hospitalized twice as often as any other age group. They accounted for a quarter of all trauma admissions. It is important that treatment be individualized for this population. It is essential to obtain early arterial blood gases. Base deficits greater than 6mmol/L have a 67% higher mortality rate in patients greater than 55 years in age. Rib fractures specifically, are more common in the elderly population due to frailty caused by osteoporosis. One study estimated 50% of patients greater than 65 years sustained rib fractures from a fall of less than six feet, compared to only 1% of patients less than 65 years sustaining rib fractures from the same fall. Pulmonary contusions occurred in 35% of patients with rib fractures. Pneumonia was evident in 10-30% of patients with rib fractures. This also resulted in longer Critical Care stays and overall hospital stays. Six or more rib fractures increased pulmonary morbidity rates by more than 50%. The Injury Severity Score (ISS) was one of the best overall predictor of outcomes in the elderly population.

Elderly patients have a higher risk of intra-abdominal injuries related to rib fractures. Boris et al. (2014) described the severity of rib fractures in elderly patients. Rib fractures in the elderly, particularly those patients 65 years and older, have an increased mortality regardless of other injuries. The number of rib fractures alone increased the potential for death in the elderly population. One complication from rib fractures is abdominal organ injury. Splenic injury occurs 6.3-23% as a direct result of rib fractures. Boris et al. (2014) conducted a study to assess the relationship between the number of fractured ribs and the severity of splenic injury. Out of 321,618 patients with blunt trauma, 14,651 were diagnosed with rib fractures. Splenic injury occurred in 1,326 (9.1%) of those patients with rib fractures. There were 2,365 (5.6%) of patients that also had splenic injury and did not have rib fractures. The study was unable to find a correlation between number of rib fractures and splenic injury severity.

The number of rib fractures does impact the risk for complications in patients. Abdulrahman et al. (2013) conducted a study to look at outcomes in patients with multiple rib fractures in comparison with age. Two groups were identified, those with multiple rib fractures less than or equal to the age of 45, and those with multiple rib fractures greater than the age of 45. All interventions were recorded such as chest tubes, intubation, and ventilation. Out of 240 patients that met the criteria for the study, 174 were under the age of 45 and 66 were over the age of 45.

Males were predominately the patients and motor vehicle crashes were the leading cause for thoracic injuries. There were no differences noted between the two groups with presence of pneumothorax, hemothorax, and lung contusion. The younger population did have more abdominal trauma and 11% required ventilation. The older

population had more insertions of chest tubes and had 10.3% requiring ventilation. Pneumonia was higher in the younger population (15.4%) and resulted in two deaths. Fifteen percent of the older population developed pneumonia resulting in one death. Overall lengths of stays were the same for both groups, but critical care stays were higher in the older adults. The overall mortality rate was 3%. This study also showed plain chest radiographs were incorrect 50% of the time when diagnosis rib fractures. More interventions were needed with the higher number of ribs fractured.

This study did not prove any significance in difference between the two groups in mortality and morbidity. It also proved that age alone does not impact the outcome. It identified the highest risk group as the older adults with four or more rib fractures. However, it also showed multiple rib fractures as having a higher mortality in any age group. Recommendations to avoid complications and death were careful assessments, respiratory support, and adequate pain control.

Rib Fractures

A correlation has been shown between mortality rates and number of rib fractures. Researchers of three studies proved rib fractures as having some of the worst outcomes (Brown & Walters, 2012). In a retrospective analysis, including 27,000 trauma patients, Stawicki et al, was able to show a significantly higher mortality rate in the elderly population with rib fractures (Brown & Walters, 2012). Measuring vital capacity (VC) of the lungs was suggested over consideration of number of ribs fractured. Bakhos et al. reported that, "patients with a VC of 1.4 liters or less, or less than 55% of their predicted VC, had extended hospital length of stay. Investigators in this study also demonstrated a strong correlation between VC and disposition at discharge (ie, home vs extended care

facility)" (Brown & Walters, 2012, p. 89). Pain management is crucial in managing patients with rib fractures. The goal is to improve inspiratory lung volumes. Brown and Walters (2012) suggested the use of epidural analgesia to assist with pain control. This method had the best results for pain control while still allowing for the ability to expand lung volumes without sedating or paralyzing. A clinical guideline was developed to include patients with four or more rib fractures, difficulty with pain management, or patients that were not able to use the incentive spirometer (IS) to receive an epidural. The use of an IS is beneficial in determining a sudden decline in respiratory status. If the patient is unable to reach his or her baseline, this could be an early indicator of severe atelectasis, pneumonia, and/or other pulmonary problems. Brown and Walters (2012) described how critical nurses play a part in optimal outcomes for patients with rib fractures. Pain management and respiratory exercises such as deep breathing and usage of IS play a big role in positive outcomes.

Ten percent of all chest traumas resulted in rib fractures (Chen & Cheng, 2014). Simple rib fractures rarely resulted in a delayed massive hemothorax, however, it is a possibility and patients should be informed of this potential complication. Chen and Cheng (2014) described how blunt chest trauma resulted in thoracic injuries 70% of the time. Lower rib fractures can result in diaphragmatic injury or intra-abdominal injuries which can sometimes be hard to diagnosis and may have delayed symptoms.

A case study was presented to help show the severity of rib fractures and potentially life threating injuries. In this case study, a 60-year-old male fell resulting in blunt trauma to his right chest. He presented to the Emergency Department and diagnosed with rib fractures of the 10^{th} and 11^{th} ribs. He was discharged with

conservative treatment. The patient later developed increased shortness of breath, rapid respirations, and increased pain in right chest. He went to another Emergency Department where a chest x-ray was completed to find a large right hemothorax with tracheal deviation. His condition began to decline rapidly. A chest tube was inserted and immediately 1,700 ml of blood returned. He was taken for an emergent thoracotomy, to find a 1 cm laceration in the right hemidiaphragm. This was repaired. The total blood loss was 5,500ml. This major complication was a result of two minor rib fractures. The delay in hemothorax can result as quickly as three to six hours, but can be delayed as long as 30 days (Chen & Cheng, 2014). The healthcare team should be aware of this potential delay when evaluating patients with chest trauma.

Rib fractures can affect quality of life. Marasco, Lee, Summerhaves, Fitzgerald, and Bailey (2015) reviewed the quality of life after a patient experienced major trauma with multiple rib fractures. Rib fractures can range from one simple rib, to very complex group of rib fractures resulting in respiratory failure. Flail chest fractures have the highest mortality rates, 33%. Acute management included analgesics for pain and respiratory support.

A study was conducted at the Alfred Hospital in Australia (Marasco et al., 2015). Approximately 1,200 major trauma patients were treated in a year and out of these, half were chest trauma patients. The mortality of these 600 patients was 5%. Data was collected on patients with major thoracic injuries and rib fractures from 2006 to 2011. Minor trauma or minor rib fractures that were treated and released in the Emergency Department were excluded from the data. The data was split into two groups, multi-trauma and thoracic injury. The multi-trauma group had higher mortality rates and

needed longer stays in the hospital. The United States data correlated to this study in that 77% of patients with rib fractures are discharged home from the Emergency Department. There is little data to support how this impacts quality of life. The pain from rib fractures can cause limitations and disability in returning to work. In this study, at month six post discharge, only 59% of the patients had returned to work. Another study suggested an average of 70 days were needed before rib fracture patients could return to work due to the pain. Due to these surprising numbers, it is essential the healthcare team focuses on early intervention of pain and respiratory support.

Data showed patients with three or more rib fractures had longer length of stays in the hospital. There was also a significant difference in decrease hospital length post-protocol implementation. Data supported early referral to the trauma physicians with elderly patients that had three or more rib fractures. This study suggested using other measures, other than mortality rates, to show effectiveness. "As outcomes in the elderly improve and mortality rate decreases, mortality becomes less useful as an indicator of recovery and process-oriented outcomes (eg, "time-to" measures such as ICU days, ventilatory days, and hospital days; functional outcomes such as discharge disposition and return to previous level of activity) gain importance" (Sahr, Webb, Renner, Sokol, & Swegle, 2013, p. 175).

Howell, Ranasinghe, and Graham (2005) described the common occurrence of rib fractures in the United Kingdom. These are most often seen in motor vehicle collisions and account for 40-60% of cases. Rib fractures most often occur at the point of impact or on the posterior angle. Fractured ribs can mimic penetrating objects once fractured. Ribs four to nine are most commonly injured. Rib fractures also lead to blood loss. It is

estimated 100-150 ml of blood is loss per rib fracture. Splenic injuries are seen from rib fractures on the left and right sided fractures are associated with liver injuries. The kidneys can also be affected if ribs 11 and 12 are involved.

Recommended Treatment

Treatment of patients with rib fractures has changed over the years. Bemelman, Poeze, Blokhuis, and Leenen (2010) provided an overview on how these treatments have transformed over the years. Techniques such as intermittent and continuous mechanical ventilation via tracheostomy were used, as well as intermittent assisted breathing through a mouth piece and endotracheal intubation. They also used skeletal traction on flail chests and strapping of the chest with adhesive tape. These have progressed to plates and fixation devises in the chest. Although the treatments have been modified over the years, they all resulted from the need to minimize respiratory complications such as intrabronchial hemorrhage, ineffectual cough, and typical anoxia. The need to expand the lungs and decrease atelectasis and respiratory failure is essential. With many different techniques used, there is still not a definitive solution. Since there is not one technique that has been widely adopted due to complications, this demonstrates the need for the NIPPV. This method is least invasive and helps achieve the same results as invasive measures. Bemelman et al. (2010) described mechanical ventilation as the gold standard and most reliable method of treatment today.

Ventilatory support is an important intervention in patients with rib fractures. Brunett, Yaris, and Cevik (2011) explained the seriousness of rib fractures as well as a focus on early ventilatory support. Rib fractures involving ribs one through three, require a large amount of forceful trauma. These fractures can result in myocardial or vascular

injuries, and bronchial tears. Poor outcomes are associated with 15-30% of these cases. Fractures in ribs nine through 11 can result in hypotension from intra-abdominal bleeding, most often the liver or spleen. Ultrasound is the most accurate diagnostic for rib and cartilaginous injuries.

The pain from rib fractures interferes with adequate ventilation, resulting in atelectasis. It is important to medicate patients with opioids, benzodiazepines, and non-steroidal anti-inflammatories to help control the pain. It is not recommended to bind or immobilize the thoracic cavity. The thoracic cavity must have room to fully expand and optimize ventilation. If the arterial PO2 is less than 80mmHg despite supplemental oxygen, ventilatory support is recommended. This is especially so in diagnosis of flail chest in elderly patients greater than 65 years with rib fractures and patients with eight or more rib fractures. Early ventilation decreases mortality when compared to cases where ventilation interventions were delayed. Intubation or NIPPV interventions are necessary to help open the alveoli and minimize air leakage (Brunett et al., 2011).

NIPPV can prevent more invasive interventions if implemented early in the plan of care. Roman (2011) defined the use of NIPPV in airway management for the trauma patient. NIPPV is useful to decrease work of breathing, decrease respiratory rate, improve functional residual capacity, and prevent hypoxemia, hypercarbia, and tachypnea. In order to have NIPPV in place, the patient must have spontaneous breathing, absence of respiratory academia or hypercarbia, intact mental status, PaO2 above 65mmHg, a functional nasogastric tube, and absence of maxiofacial injury. One study showed an improvement of gas exchange after NIPPV was implemented which allowed intubation to be avoided in a patient with blunt chest trauma. NIPPV in patients with flail

chest decreased mortality rates and pulmonary infection rates. However, this study did not show an effect on length of stay in the critical care unit.

NIPPV improved patient outcomes. Douglas, Schmidt, and Hall (2005) expounded on NIPPV in the use of Acute-on-Chronic Respiratory Failure (ACRF). There were 14 randomized controlled studies focusing on the use of NIPPV verses the usual medical care (UMC). There were 758 patients in the studies with ACRF, ranging in ages 63-76 years old. Admission pH's ranged from 7.26-7.34, PaCO2 ranged from 57-87mmHg, and PaO2 ranged from 39-73mmHg. After the meta-analysis, it was determined treatment failure occurred less in patients that received NIPPV over those that received UMC. Mortality rates decreased by 48% and there was a 60% reduction in the need to intubate. Hospital length of stay was reduced by 3.24 days overall. There was not a significance noted in decrease in number of critical care days.

Intervention of NIPPV can reduce length of hospital stays and improve outcomes. Poponick, Renston, Bennett, and Emerman (1999) conducted a study to prove the effectiveness of a ventilator support system (NIPPV) for patients in acute respiratory failure. Trials with NIPPV were conducted on 58 patients, and 43 of these trials were successful. Success was determined by a post 30 minute arterial blood gas. The post-trial ABG levels showed the difference between nonintervention and intervention (pH 7.34 verses 7.27mmHg and PaCO2 61.9 verses 73mmHg). There were differences noted in length of stay in the critical care unit as well. Those that had not received NIPPV had an average length of stay of 12.3 days on the critical care unit and those with NIPPV intervention had an average of 4.2 critical care days. Overall hospital days were also

affected. NIPPV intervention resulted in 8.1 less days in the hospital. This study supported the early implication of NIPPV in stable acute respiratory failure patients.

Adult Respiratory Distress Syndrome (ARDS) is common in patients with pulmonary contusions. The internal hemorrhage in the lung decreases lung compliance and increases pulmonary vascular resistance. Gas exchange becomes very difficult. An inflammatory response also occurs and this leads to 50-60% of patients developing ARDS (Howell et al., 2005). Pulmonary contusions can lead to pulmonary sepsis. These patients should be monitored in a critical care setting. Aggressive pain control and physiotherapy is recommended in these patients. Sometimes the need for positive pressure ventilation will also be necessary.

There is not a standardized approach to treat blunt thoracic trauma. Reske, Seiwerts, Reske, Gottschaldt, and Schreiter (2006) explained how challenging blunt thoracic trauma can be to treat. Supplemental oxygen or NIPPV can be used in some patients, but others required a more invasive approach due to early onset of pneumonia, atelectasis, and hypoxia. A case study was presented to suggest another method of treatment for ARDS. A 17-year old presented, intubated in the field, due to blunt chest trauma. The patient was diagnosed with ARDS as a result of pulmonary contusion. After unsuccessful attempts to improve oxygenation with low tidal volumes and high positive end-expiratory pressures (PEEP), an alveolar recruitment maneuver was applied seven hours after admission. PEEP was then titrated to the lowest level. This method increased oxygenation and lung compliance dramatically, and the lung was completely aeriated after 27 hours of the procedure. This evidence supported early alveolar recruitment.

Blunt thoracic trauma should be managed aggressively. The American College of Surgeons in the Advanced Trauma and Life Support have guidelines to follow for these types of injuries (Howell et al., 2005). According to these guidelines, the primary survey (airway, breathing, circulation, and disability) should be assessed first. The patient should be exposed and examined thoroughly and a full set of vital signs should be obtained. Labs should be collected; this includes blood count, electrolytes, type and screen, and arterial blood gas. Electrocardiograph is also recommended. An x-ray is important to obtain within the first 10 minutes of the patients arrival. A computed tomography (CT) is also indicated to help diagnose pulmonary contusions and other internal injuries.

Early interventions in patients with rib fractures resulted in decreased hospital stays. Sahr et al. (2013) described a study of early implementation of triage protocols in elderly trauma patients with rib fractures. Emergency room physicians and trauma physicians developed a protocol to treat patients with rib fractures. Patients with three or more rib fractures, hemodynamically unstable, hemopneumothorax, or had risk factors of morbidity and mortality including age greater than 64, fall higher than ground level, and taking anticoagulants were automatically referred to the trauma service. The Emergency Department physicians treated patients that fell outside of the above criteria with two or fewer rib fractures. The hospital length of stay was used to measure the effectiveness of the protocol. The study looked at two time frames, pre and post protocol implementation. The pre-protocol phase had 81 participants and the post-protocol phase had 67 patients.

There are multiple complications that support the need for early intervention in patients with rib fractures. Hemmila and Wahl (2010) reiterated the importance of early

intervention with rib fractures. A simple rib fracture may only present as pain on inspiration. This can be treated with analgesics and the patient can be discharged. However, it is extremely important to teach the patient how to deep breath and cough to ensure adequate ventilation at all times. Multiple rib fractures may need intercostal nerve blocks or epidural analgesia. These patients should be admitted for observation and pain control. It is important to do serial arterial blood gases on these patients. The first sign of inadequate ventilation may only be a decreased PaO2 on the arterial blood gas. It is important to intervene early if the PaO2 is dropping. Multiple rib fractures are known for a voluntary decrease in respiratory efforts. Pneumonitis is very common in the elderly patient with multiple rib fractures. A lung contusion may not be evident initially. It can take up 12-48 hours for these to appear. Lung contusions cause a decrease in lung compliance, resulting in hypercapnia, hypoxia, accumulation of secretions, and an ineffective cough. Most of these cases do require ventilator assistance.

Pneumonia is one of the complications in patients with rib fractures. Chauny et al. (2012), conducted a study to evaluate the prevalence of pneumonia in post-thoracic trauma patients. The goal of this study was to evaluate the number of incidents with delayed pneumonia as a result of rib fractures as well as identifying risk factors for delayed pneumonia. Participants included anyone that was discharged from the Emergency Department, over the age of 16, with a diagnosis of minor thoracic injury. Patients were assessed and had a thorax plus chest radiograph completed. At weeks one and two the patients were followed up with the Emergency Physician and research assistant. Posterior-anterior and lateral chest x-rays were completed at this time. The research assistants conducted phone interviews at weeks four and 12. There were 1,057

participants that consented to treatment. Six patients had pneumonia at the two-week check-up. No pneumonia was noted from the four and 12 week follow-up calls. Risk factors for delayed pneumonia included preexistent pulmonary disease such as chronic obstructive pulmonary disease and asthma. Age, sex, smoking, and alcohol consumption, did not prove to be risk factors. One flaw of the study included the physicians' choice for radiographs. The sensitivity is poor, so there may have been missed diagnoses. Another flaw was the exclusion of the admitted patients. Overall, the study showed less than 1% of participants developed delayed pneumonia.

A study was conducted and developed a prognostic model for predicting complications related to blunt chest wall trauma (Battle et al., 2014). Because chest wall trauma accounts for more than 15% of all trauma admissions worldwide and mortality can range from 4-60%, Battle et al. (2004) saw the need to develop a reliable tool to better predict trauma complications. Risk factors were evaluated and scored. These included, age, pre-existing lung disease, anticoagulants, and number of ribs fractured. The study was conducted in South Wales between 2009 and 2011. The tool was tested and proved to be reliable. The higher the score the higher risk the patient was for developing serious complications. This tool could be used in conjunction with early NIPPV support.

Invasive and non-invasive methods can be used to treat chest trauma. Qasim and Gwinnutt (2009) suggested management of flail chests or rib fractures by two categories, surgical and non-surgical. The non-surgical options focused on administration of analgesics, ventilator assistance, and fluid replacement strategies. It was common to electively intubate these patients in the 1950's. Later research showed patients that were

not intubated had better outcomes. This research led to the focus on less invasive ventilatory support. Early supplemental oxygen and NIPPV showed to have 20% mortality verses 33% in those that did not receive NIPPV. This supported using non-invasive methods for management of flail chest and rib fractures.

Literature Related to Conceptual Framework

The Theory of Symptom Management is a middle range theory developed by the University of California, San Francisco. This multidimensional process was developed from three main concepts. These include the patient's perception of the symptoms, interventions, and approaches related to the symptoms, and outcomes (Brant, Beck, & Miaskowski, 2010). This theory looked at symptom management through the individual, the environment, and health concepts. The comprehensiveness of this theory allowed the symptoms to be more adequately controlled and interventions started earlier in the plan of care. Fu, McDaniel, and Rhodes (2007) described the need for effective symptom management in patients with cancer, heart disease, acquired immunodeficiency syndrome, and respiratory disease. Symptom management drives outcomes. The limitations of the theory arose when multiple symptoms interact and when evaluation of symptoms occur. Multiple symptoms may cause confusion in trying to intervene appropriately. Also, the evaluation may differ among providers.

Symptoms can be a subjective experience which can be more difficult to manage and measure. Objective signs can also be present such as change in vital signs, or nursing assessment. The nurse and provider must complete a thorough assessment and reassess frequently to help intervene early in the plan of care. The healthcare team must also be aware of risk factors and other co-morbidities that could lead to a decline in health status.

The Theory of Symptom Management in the elderly population with rib fractures was designed to intervene early and have a proactive approach. The purpose was to incorporate subjective and objective symptoms to develop necessary interventions that will lead to optimal outcomes. Please refer to Figure 1 “Symptom Management Model” below (Liehr, 2005).

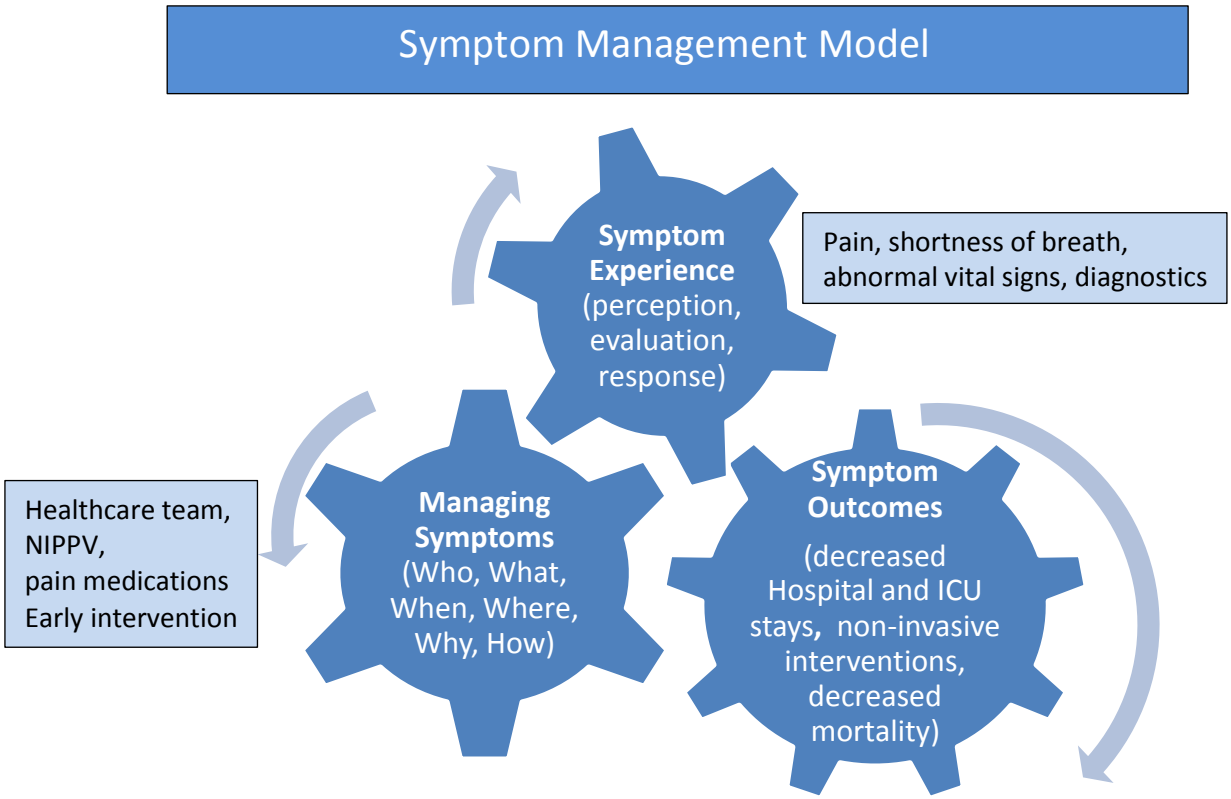

Figure 1: Symptom Management Model

As elderly patients present with rib pain or trauma, the goal would be to evaluate the symptoms immediately. The health care team should look at all aspects including the patient's perception, subjective and objective data, environmental factors, and history. Once this information is evaluated, a response should be developed for management of the symptoms. The healthcare team should clearly define who, what, when, where, why and how. Once the plan has been developed and acted upon, this should positively affect the patient by having overall better outcomes, decreasing hospital and Intensive Care Unit (ICU) stays, less invasive interventions, and a decrease in mortality rates. The goal specific to this research, in patients greater than 65 years with rib fractures, was to intervene quickly after evaluation of symptoms with NIPPV in hopes to improve ventilation and increase overall quality of care.

Strengths and Limitations of Literature

The strengths of the literature supported the need for a more standardized care model for patients 65 years and older with a diagnosis of rib fractures. The literature described the increased risk of poor outcomes and mortality with multiple rib fractures in the elderly population. NIPPV was also suggested as a non-invasive intervention to improve ventilation. The largest risk with rib fractures is a compromised respiratory system. NIPPV helps reduce this risk if implemented early in the plan of care. The literature supported pain and ventilator interventions in rib fracture diagnosis.

The limitations of the literature included the limited amount of studies directly correlating NIPPV as an appropriate intervention in patients 65 years and older with rib fractures. Multiple studies and case reviews supported NIPPV use and also described the risk factors related to rib fractures; however, none of these studies suggested a

standardized approach for treatment of this population. The inability to compare studies was a limitation in this research.

CHAPTER III

Methodology

In order to determine the effectiveness of NIPPV in patients 65 years and older with rib fractures, a study was completed. The specific design, sample population, data collection process, and measurement methods were defined prior to collection of the data. The purpose of this study focused on improving outcomes for patients 65 years and older with rib fractures.

Study Design

The design used for this study involved a retrospective analysis of implementation and non-implementation of NIPPV in patients with rib fractures 65 years and older. This analysis determined the effectiveness of NIPPV intervention. This quantitative study correlated early intervention of NIPPV in rib fracture patients 65 years and older to positive outcomes.

Population/Sample/ Setting

The population included all patients 65 years and greater admitted to a Level II Regional Trauma Center with a diagnosis of rib fractures in 2013 and 2014. Patients 65 years and older were selected because they are at a greater risk for mortality related to rib fractures. The sample size included a total of 117 patients. All patients with injuries other than rib fractures and extremity orthopedic injuries were excluded from the study.

Design for Data Collection

The data was abstracted from the Digital Innovations Trauma Registry, Version 5. This data showed the age of the patient, admitting diagnosis code, admission unit, emergency department length of stay, ICU length of stay, overall hospital length of stay,

ISS, and discharge disposition. Unplanned ICU data was abstracted from Midas. Cerner was used to determine interventions during the plan of stay. The data was analyzed and the patients with NIPPV intervention were compared to those without. The data was also analyzed to see if there were correlations between ISS, pre-existing co-morbidities, complications, time of NIPPV intervention, invasive procedures, admission unit, pain management, hospital length of stay, and dispositions. An excel spreadsheet was maintained as the data was manually entered and categorized.

Measurement Methods

A retrospective data analysis was completed to measure outcomes. These included time frame from arrival to NIPPV intervention, unplanned ICU admission and length of stay, overall hospital length of stay, need for other invasive interventions, ISS, pre-existing comorbidities, complications, pain management, and discharge disposition. This data analysis compared categories of patients that did not receive NIPPV, those that received NIPPV from the first to 24 hours of arrival and those that received NIPPV after the first 24 hours.

Data Collection Procedure

Data collection was conducted with the assistance of the research department as well as the Trauma Clinical Coordinator. A meeting was conducted to review what data was needed for the study. All data omitted patient identifiers with the exception of age. Any patient greater than 90 years was listed as > 90 years. The specific age was not identified. The data was collected in a retrospective approach from 2013 and 2014.

Protection of Human Subjects

Patients greater than 90 years of age are more subject to identification so these patients were de-identified by categorizing all as > 90 years old. The Institutional Review Board, prior to data collections and analysis, approved this research study. Patients were not at risk during this study since this was a retrospective analysis. All data was kept confidential in a computer database protected by password entry.

Data Analysis

The statistical program, SAS, was used for data analysis. A statistician, Dr. Steven Patch, assisted with inputting the data and analysis. Statistical significance and correlation of variables of outcomes were shown. Sample size, standard deviations, and variance were also demonstrated.

CHAPTER IV

Results

Promoting outcomes in patients 65 years and older with rib fractures was the main focus of this study. NIPPV is a non-invasive ventilatory mechanism and should assist in positive outcomes if implemented early on in the plan of care. Respiratory failure, ARDS, and pneumonia are some of the complications that can lead to increased hospital length of stays, increase in invasive procedures, and poorer outcomes. A study was conducted to evaluate the effectiveness of early intervention of NIPPV in patients 65 years and older with rib fractures.

Sample Characteristics

A total of 150 patients were pulled from the Digital Innovations Trauma Registry, Version 5. Patients with a diagnosis of three or more rib fractures and orthopedic injuries in extremities were included. Patients with internal organ injuries and head injuries were excluded. This narrowed the sample size to 117 total patients, in 2013, 62 patients qualified and in 2014, 55 patients qualified for the study. Comorbidities were also accounted for that directly impacted the respiratory system. These included patients with a history of Chronic Obstructive Pulmonary disease (COPD) or emphysema, Congestive Heart Failure (CHF), Asthma, Sleep Apnea, and Pulmonary Edema.

Table 1

Data Sample

Year	Sample Size
2013	62
2014	55
Total	117

Major Findings

Does early NIPPV intervention promote positive outcomes among older adults, 65 years and older, with a rib fracture diagnosis? The data was analyzed and the Time Until NIPPV intervention was divided into three categories: Never, 1-24 hours, and >24 hours. Because only four patients were intubated prior to receiving NIPPV, they were not included in the analysis. (Another patient was dropped from all analyses because they were the only one admitted to the Stepdown Unit.) To examine the univariate relationships between Time Until NIPPV and the quantitative variables (LOS ICU, LOS Hospital, Age, ISS and Rib Fractures) the medians and quartiles were calculated. Because some of the quantitative variables were non-normal, a Kruskal-Wallis test was used to determine if there was a significant relationship between Time Until NIPPV and the quantitative variable. To examine the relationship between Time Until NIPPPV and the categorical variables (Comorbidities, Invasive Procedures, Complications,

Ventilation, Admitting Unit) an exact Pearson Chi-Square test was performed to produce the p value.

To determine which variables were related to length of stay in the ICU (LOS ICU) and the hospital (LOS Hosp), a stepwise general linear model was utilized. The variables that were considered as possible predictors were Time Until NIPPV, Comorbidities, Invasive Procedures, Complications, Ventilation, Admitting Unit, Age, ISS and Rib Fractures. Variables must have had a p-value of less than 0.05 to enter or stay in the model. Because both lengths of stays were positively skewed, the natural logarithm length of stay was used as the response variable. (For LOS ICU, log (LOSICU+1) was used because several patients had LOSICU=0.) Because Admitting Unit (ICU or Med./Surg,) is clearly related to LOS ICU (most of the Med/Surg patients had 0 days in ICU) it was not included in the stepwise analysis for LOS ICU. (Statistical Results, Table 2 and Table 3)

Statistical Results

Table 2

Relationship of Time until NIPPV to Quantitative Variables

	Time until NIPPV			
	Never Median(Q1-Q3)	1 - 24 Hours Median(Q1-Q3)	>24 Hours Median(Q1-Q3)	p-value
LOS ICU	0 (0-0)	1.5 (0-3)	1 (0-2)	0.009
LOS Hospital	5 (3-8)	8 (4-10)	8 (6-14)	0.012
Age	75 (69-85)	77 (73-86)	73(71-82)	0.520
ISS	10 (9-14)	11 (9-14)	9 (9-17)	0.911
Rib Fractures	4 (4-6)	5 (4-6)	4 (3-6)	0.699

Table 3

Relationship of time until NIPPV Administered to Categorical Variables

	Time until NIPPV		
p-value	Never	1 - 24 Hours	>24 Hours
	n=91 (81.3%)	n=10 (8.9%)	n=11 (9.8%)
Comorbidities (n=49)	65.2%	17.4%	17.4%
0.085			
Invasive Procedures (n=42)	76.2%	9.5%	14.3%
0.500			
Complications (n=49)	65.3%	18.4%	16.3%
0.000			
Admitted to ICU	86.8%	6.0%	7.2%
0.038			
Vented (n=11)	72.7%	9.1%	18.2%
0.836			

For the response variable log (LOS ICU) the stepwise general linear model selected the variables Venting (p = 0.000), Complications (p = 0.000), and ISS (p = 0.019) as the variables that were related. In the model that included those variables Time Until NIPPV was not significantly related to log (LOS ICU) (p = 0.165).

For the response variable log (LOS ICU) the stepwise general linear model selected the variables Venting (p = 0.027), Complications (p = 0.000), Invasive Procedures (p = 0.000) and Admission Unit (p = 0.019) as the variables that were related. In the model that included those variables Time Until NIPPV was not significantly related to log (LOS Hospital) (p = 0.400).

Summary

The patients who never had NIPPV had a significantly lower LOS ICU and LOS Hospital medians (Table 2) than those having it within1-24 hours or after 24 hours. However patients with complications were significantly more likely to have NIPPV within1-24 hours or after 24 hours (Table 3). Patients admitted to the ICU were significantly less likely to have never had NIPPV (Table 3). There were no significance noted with NIPPV intervention and comorbidities or reduction of invasive procedures and complications.

CHAPTER V

Discussion

Early intervention of NIPPV in elderly patients 65 years and older with rib fractures should promote positive outcomes. Many patients admitted for rib fracture diagnosis do not only have rib fractures as a diagnosis. Many of these patients have other internal injuries from blunt trauma, or orthopedic injuries that lead to decreased mobility and can lead to more complications and longer hospital length of stays. The data was challenging to analyze due to the complexity of the variables.

Implication of Findings

There were no significant findings or correlations with NIPPV intervention and ISS, age, number of rib fractures, comorbidities, or invasive procedures. Time Until NIPPV had a significant effect on LOS ICU and LOS Hospital when considered by itself but when adjusting for other variables it did not. This suggested that the other issues associated with more serious problems may make it more likely that patients receive NIPPV and that NIPPV was not the cause of longer ICU and hospital LOS's. It is possible that even after adjusting for these variables, patients with more serious conditions in some other dimension might be more likely to receive NIPPV, which could hide a potential beneficial effect of early NIPPV. It should be noted that only 10 patients had NIPPV within 24 hours and 11 after 24 hours so there would have to be a large effect to be able to find a significant relationship. To fully understand the relationship of Time Until NIPPV on length of stays a large randomized trial would need to be conducted. However the practical and ethical issues associated with such a study would make it difficult, if not impossible, to conduct.

Application to Conceptual Framework

The Theory of Symptom Management is an appropriate framework to use with this study. One of the limitations of this theory was managing multiple symptoms interactions and appropriate evaluation when the symptoms occur. This related directly to this study. All patients in the study had a secondary diagnosis other than rib fractures. This led to challenges with managing multiple symptoms. The findings of the study were significant in patients admitted to ICU not requiring NIPPV intervention. This may be related directly to the management of risk factors associated with rib fractures and more one on one nursing care. There was a heightened awareness of ensuring rib fractures are treated with early pulmonary toileting and more frequent assessments and vital signs in the ICU than on the medical floors. This more direct nursing care could lead to decreasing the need for NIPPV if symptoms or potential for symptoms are managed more closely. The Theory of Symptom Management described three main concepts, the individual, the environment, and health concepts. Treatment of these elderly patients with rib fractures in the ICU aligned with these concepts.

Limitations

Limitations to this study included a retrospective analysis, admitted patients included more diagnoses than rib fractures alone, the study was limited to one organization and treatment plan, the sample size for patients with NIPPV intervention was low (total of 21 patients), multiple caregivers were included in providing care, complications non-related to rib fractures were not excluded from the data analysis, and many patients also had other injuries limiting mobility which may have resulted in longer LOS and more complications. A retrospective analysis was a limitation because no

variables could be controlled. Patients with multiple diagnoses were a part of the study because the majority of patients with rib fractures were involved in an accident that resulted in other injuries. There were no patients in the data with only a diagnosis of rib fractures. The study was conducted in one organization. This organization may be a limiting factor to the study protocols and guidelines are systematic and all healthcare providers and team members have the same annual education. These were all limitations to the study affecting the results.

Implications for Nursing

The study did not prove early intervention of NIPPV would lead to positive outcomes. However, it did not show significant correlation with negative outcomes either. Thus meaning NIPPV intervention did not harm the patient. Given the limitations of the study, there could still be advantages to NIPPV in elderly patients with rib fractures. NIPPV assisted with ventilation in a non-invasive way. Keeping the alveoli open and decreasing possible pulmonary complications is essential in promoting positive outcomes in rib fracture patients.

The study showed significance in patients who never had NIPPV and decreased LOS in ICU. Patients that were on NIPPV were placed on it in a reaction to a negative decline in status, most often other complications. It is important for nurses to receive education about risk factors associated with rib fractures in the elderly population. Rib fractures can result in life threatening complications. Nurses need to be aware of early symptom management through pain management and pulmonary toileting. A pro-active approach to treatment should be instilled verses a reactive approach. Managing multiple symptoms was also a necessity for proper care in patients with rib fractures. Increasing

the awareness of subjective and objective symptoms would be beneficial for the healthcare team as well. Close observation and frequent assessments are vitally important in proper symptom management in these patients.

Recommendations

A large randomized trial would need to be conducted to have a clearer picture of the relationship between NIPPV and positive outcomes in elderly patients 65 years and older and rib fractures. Exclusion of non-related rib fracture complications and effects on length of stay would be important. A study where NIPPV was implemented as a standard proactive approach to care within the first 24 hours in the ICU setting would be most beneficial to see exact correlations with outcomes. There would be some challenges with ethical and practical issues that may limit the feasibility of this study. Control of the timing of NIPPV intervention, a controlled environment, and controlled nursing care, would all be benefits of this study. The number of patients with NIPPV would be substantially more thus leading to an increase in validity of data.

Conclusion

Patients who never had NIPPV intervention had a significantly lower LOS in the ICU and hospital than those that required NIPPV in the first 24 hours or greater. Patients with complications were significantly more likely to have NIPPV within the first 24 hours or more. Patients admitted to the ICU were significantly less likely to never had NIPPV. Time until NIPPV intervention was not significant in the LOS of ICU patients or overall hospital LOS. The beneficial factor of early intervention of NIPPV could be disguised by the fact more serious complications required NIPPV intervention. The study did not show significance for correlations with positive outcomes and NIPPV

intervention; however, it did not show negative outcomes either. NIPPV intervention in elderly patients 65 years and older with rib fractures was a proactive approach in potentially decreasing complications and negative outcomes.

References

Abdulrahman, H.H., Afifi, I.I., El-Menyar, A.A., Al-Hassani, A.A., Almadani, A.A., Al-Thani, H.H., & Latifi, R.R. (2013). Clinical outcomes of multiple rib fractures: does age matter? *European Journal of Trauma and Emergency Surgery*, *39*(6), 605-611. doi:10.1007/500068-013-0291-5

Battle, C.E., Hutchings, H., Lovett, S., Bouamra, O., Jones, S., Sen, A.,… & Evans, A. (2014). Predicting outcomes after blunt chest wall trauma: development and external validation of a new prognostic model. *Critical Care*, *18*(3), R98. doi: 10.1186/cc13873

Bemelman, M., Poeze, M., Blokhuis, T., & Leenen, L. (2010). Historic overview of treatment techniques for rib fractures and flail chest. *European Journal Of Trauma & Emergency Surgery*, *36*(5), 407-415. doi:10.1007/s00068-010-0046-5

Boris, K., Forat, S., Itamar, A., Oded, O., Kobi, P., Adi, G.,…& Ricardo, A. (2014). Increasing number of fractured ribs is not predictive of the severity of splenic injury following blunt trauma: An analysis of a National Trauma Registry database. *Injury*, *45*(5), 855-858. doi:10.1016/j.injury.2013.12.011

Brant, J., Beck, S., & Miaskowski, C. (2010). Building dynamic models and theories to advance the science of symptom management research. *Journal Of Advanced Nursing*, *66*(1), 228-240. doi:10.1111/j.1365-2648.2009.05179.x

Brown, S.D., & Walters, M.R. (2012). Patients with rib fractures. *Journal of Trauma Nursing*, *19*(2), 89-93. doi: 10.1097/JTN.0b013e31825629ee

Brunett, P.H., Yarris, L.M., & Cevik A. (2011). Chapter 258. Pulmonary Trauma. In Tintinalli J.E., Stapczynski J, Ma O, Cline D.M., Cydulka R.K., Meckler G.D., T (Eds), *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7e.* Retrieved March 08, 2015 from http://accessmedicine.mhmedical.com.ezproxy.gardner-webb.edu/content.aspx?bookid=348&Sectionid=40381746

Burlew C.N., & Moore E.E. (2014). Trauma. In Brunicardi F, Andersen D.K., Billiar T.R., Dunn D.L., Hunter J.G., Matthews J.B., Pollock R.E. (Eds), *Schwartz's Principles of Surgery, 10e.* Retrieved March 08, 2015 from http://accessmedicine.mhmedical.com.ezproxy.gardner-webb.edu/content.aspx?bookid=980&Sectionid=59610848

Chauny, J., Emond, M., Plourde, M., Gulmont, C., Le Sage, N., Vanier, L., &…Fratul, R. (2012). Patients with rib fractures do not develop delayed pneumonia: a prospective, multicenter cohort study of minor thoracic injury. *Annals of Emergency Medicine, 60*(6), 726-731. Doi:10.1016/J.annemergmed.2012.03.020

Chen, C., & Cheng, Y. (2014). Delayed massive hemothorax complicating simple rib fracture associated with diaphragmatic injury. *American Journal of Emergency Medicine, 32*(7), 818.e3-4. doi:10.1016/j.ajem.2013.12.060

Daily, J.C. & Wang, H.E. (2011). Noninvasive positive pressure ventilation: resource document for the national association of ems physicians position statement. *Prehospital Emergency Care, 15*(3), 432-438. doi:10.3109/10903127.2011.569851

Dodd, M., Janson, S., Facione, N., Faucett, J., Froelicher, E., Humphreys, J., &…Taylor, D. (2011). Advancing the science of symptom management. *Journal of Advanced Nursing, 33*(5), 668-676. doi: 10.1046/j.1365-2648.2001.01697.x

Douglas, I.S., Schmidt, G.A., & Hall, J.B. (2005). Chapter 39. Acute-on-Chronic Respiratory Failure. In Hall J.B., Schmidt G.A., Wood L.H. (Eds), *Principles of Critical Care, 3e.* Retrieved March 08, 2015 from http://accessmedicine.mhmedical.com.ezproxy.gardner-webb.edu/content.aspx?bookid=361&Sectionid=39866407.

Fu, M., McDaniel, R., & Rhodes, V. (2007). Measuring symptom occurrence and symptom distress: development of the symptom experience index. *Journal Of Advanced Nursing, 59*(6), 623-634.

Hemmila, M.R., & Wahl, W.L. (2010). Chapter 13. Management of the Injured Patient. In Doherty G.M. (Eds), *CURRENT Diagnosis & Treatment: Surgery, 13e.* Retrieved March 08, 2015 from http://accessmedicine.mhmedical.com.ezproxy.gardner-webb.edu/content.aspx?bookid=343&Sectionid=39702800.

Howell, N. J., Ranasinghe, A. M., & Graham, T. (2005). Management of rib and sternal fractures. *Trauma*, *7*(1), 47-54. doi:10.1191/1460408605ta332oa

Kallet, R. (2011). Patient-ventilator interaction during acute lung injury, and the role of spontaneous breathing: part 2: airway pressure ventilation. *Respiratory Care, 56*(2), 190-206. doi: 10.4187/respcare.00968

Levy, D. & Choi, K. (2012). Chapter 2681. *Harvison's Principles of Internal Medicine.* Retrieved from http://accessmedicine.mhmedical.com

Liehr, P. (2005). Looking at symptoms with a middle-range theory lens. *Advanced Studies in Nursing, 3*(5), 152-157.

Lu, M., Huang, Y., Liu, Y., Liu, H., & Kao, C. (2008). Delayed pneumothorax complicating minor rib fracture after chest trauma. *American Journal of Emergency Medicine, 26*(5) 51-54.

Marasco, S., Lee, G., Summerhayes, R., Fitzgerald, M., & Bailey, M. (2015). Quality of life after major trauma with multiple rib fractures. *Injury, 46*(1), 61-65. doi:10.1016/j.injury.2014.06.014

Poponick, J., Renston, J., Bennett, R., & Emerman, C. (1999). Use of a ventilatory support system (BIPAP) for acute respiratory failure in the emergency department. *Chest 116*(1). 166-171.

Qasim, Z., & Gwinnutt, C. (2009). Flail chest: pathophysiology and management. *Trauma, 11*(1), 63-70.

Reske, A., Seiwerts, M., Reske, A., Gottschaldt, U., & Schreiter, D. (2006). Early recovery from post-traumatic acute respiratory distress syndrome. *Clinical Physiology & Functional Imaging, 26*(6), 376-379. doi:10.1111/j.1475-097X.2006.00702.x

Roman, A. (2011). Chapter 28. Noninvasive Airway Management. In Tintinalli J.E., Stapczynski J, Ma O, Cline D.M., Cydulka R.K., Meckler G.D., T (Eds), *Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7e.* Retrieved

March 08, 2015 from http://accessmedicine.mhmedical.com.ezproxy.gardner-webb.edu/content.aspx?bookid=348&Sectionid=40381490

Sahr, S.M., Webb, M.L., Renner, C., Sokol, R.K., & Swegle, J.R. (2013). Implementation of a rib fracture triage protocol in elderly trauma patients. *Journal of Trauma Nursing*, *20*(4), 172-175. Doi:10.1097/JTN.0000000000000008

Sarkar, S. (2009). Major trauma in the elderly. *Trauma*, *11*(3), 157-161.

Square, A. I. S. (2010). Injury Severity Score. Retrieved from http://traumaregistry.eurac.edu

Winters, B. (2009). Older adults with traumatic rib fractures: an evidence-based approach to their care. *Journal of Trauma Nursing, 16*(2), 93-97. doi: 10.1097/JTN.0b013e3181ac9201

Yee, W.Y., Cameron, P.A., & Bailey, M.J. (2006). Road traffic injuries in the elderly. *Journal of Emergency Medicine 23,* 42-46.